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ORIGINS OF CHUM SALMON (Oncorhynchus keta) IN THE

EXCURSION INLET PURSE SEINE FISHERY OF 1981 BASED

ON SCALE PATTERN ANALYSIS

By

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ABSTRACT

Linear discriminant analysis of scale patterns of five-year-old chum salmon
(Oncorhynchus keta) and age composition data obtained from escapements in
the Excursion, Chilkat, and Taku Rivers and commercial catches in Excursion
Inlet, Southeastern Alaska, provided the basis for apportioning the catch
into component stocks. The harvest of 97,799 chum salmon in the Excursion
Inlet fishery was comprised of 68,258 (69.8%) Excursion River fish and 29,541
(30.2%) non-Excursion River (Chilkat and Taku) fish. Test fishery catches
from sites outside the restricted southern boundary of the Excursion Inlet
fishery revealed higher proportions of Chilkat and Taku River fish, suggest-
ing that the boundary restriction has been successful in reducing the inter-
ception of fish destined for the Chilkat and Taku Rivers.

INTRODUCTION

Excursion Inlet is located along Icy Strait approximately 80 kilometers west of Juneau, Alaska (Figure 1). A purse seine fishery operates at Excursion Inlet between late August and late September. All five species of Pacific salmon (*Oncorhynchus* sp.) are harvested, but the target species is chum salmon (*O. keta*).

Chum salmon migrate into the inland waters of northern Southeastern Alaska primarily through Icy Strait. Chum salmon from this region are classified into two groups based on the time of return of adult spawners. Summer chum salmon return from June through early August and are harvested incidentally in fisheries targeted on pink and sockeye salmon. Fall chum salmon return from mid-August through early October and most spawn in three large river systems; the Chilkat, Excursion, and Taku Rivers. Small runs of fall chum salmon return to a number of other streams, including Chaik Bay Creek, Weir Creek (Hood Bay), Chilkoot River, Endicott River, Antler River, and Whiting River.

Three main fisheries harvest fall chum salmon in northern Southeastern Alaska. Gillnet fisheries in Lynn Canal (District 115) and Taku Inlet (District 111) operate in terminal areas and harvest fish primarily from the Chilkat and Taku River drainages. The annual harvest of chum salmon in the District 115 fishery during the period 1972 to 1981 has varied from 113,459 to 439,204, averaging 241,213 fish. During the same period, between 2,464 and 192,750 chum salmon have been harvested annually in the District 111 fishery with an average annual catch of 86,320 fish. The average annual catch between 1972 and 1981 in the Excursion Inlet purse seine fishery, including 1977 and 1978 when the fishery did not open, was 61,044 chum salmon.

Fishery openings at Excursion Inlet are made by emergency order when aerial surveys indicate that a sufficient number of fish are in the area. Aerial surveys are often complicated by poor visibility because of inclement weather and the glacial turbidity of the Excursion River, which empties into the Inlet. The fishery has traditionally operated in those waters of Icy Strait north of the latitude of the southernmost tip of South Porpoise Island, and east of a line from Excursion Point that bisects South Porpoise Island (Figure 2). Concern has recently been expressed by both user groups and fishery managers that large numbers of moving fish not destined for the Excursion River are being intercepted in the fishery. In an effort to minimize the catch of fish bound for other river systems, the fishing boundaries were restructured in 1980 and 1981. The southernmost boundary of the fishing area is now located at the latitude of Excursion Point (58°22'36"N). No quantitative evidence has been previously available, however, to support the effectiveness of this strategy.

The potential of scale pattern analysis in separating stocks of chum salmon in the Excursion Inlet fishery has been demonstrated (Oliver 1981[1]). Staff

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[1] Oliver, Glen. Scale pattern based stock separation study of Excursion Inlet chum salmon. Alaska Department of Fish and Game, unpublished report, 1981.
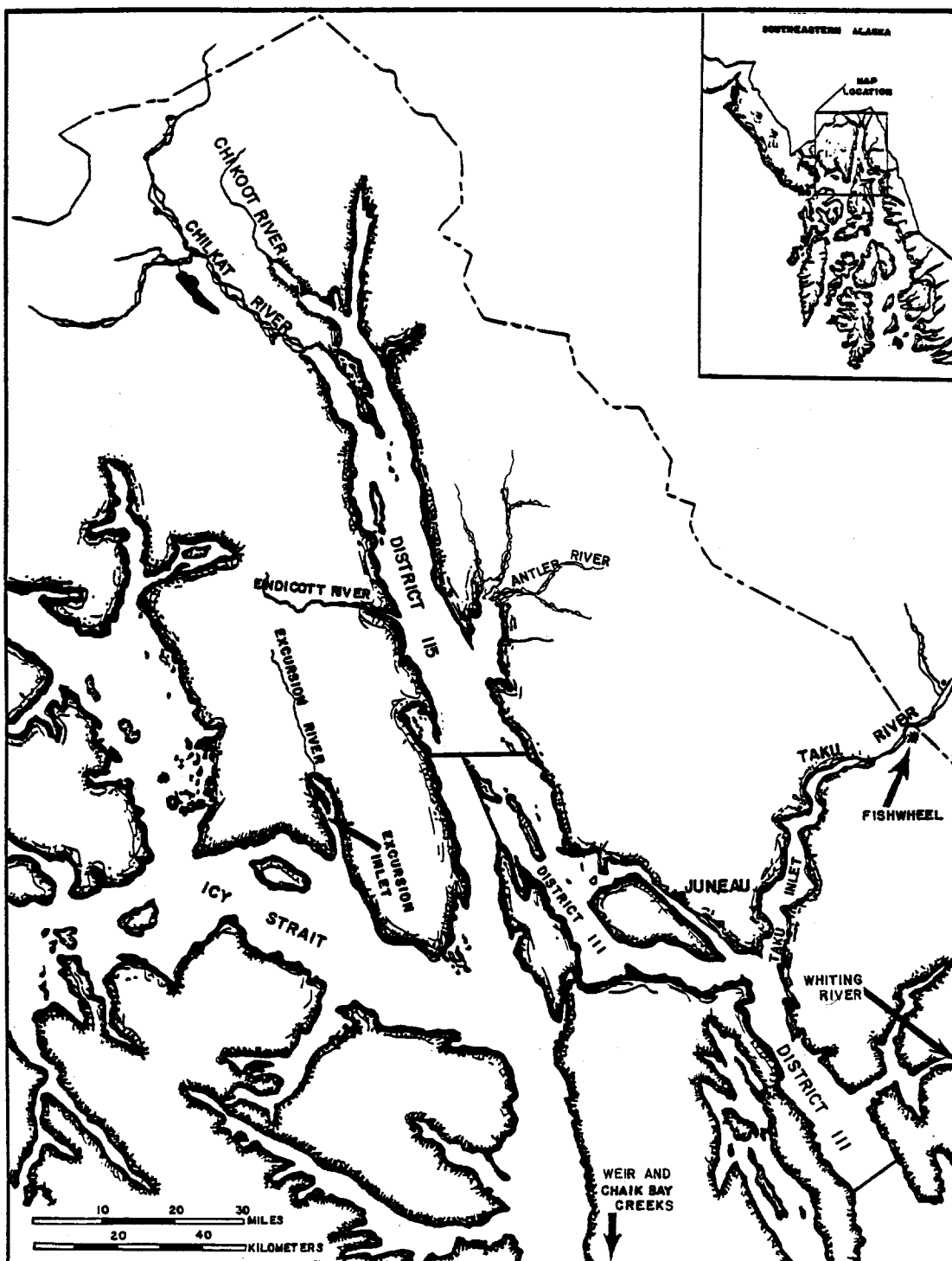
Figure 1. Map of northern Southeastern Alaska showing the locations of Districts 111, 115, and Excursion Inlet, and the major fall chum salmon spawning drainages.

TEST FISHERY SITES
1. Excursion River Mouth
2. Sawmill Pt.
3. Homeshore Line
4. Excursion Pt.
5. North Porpoise
6. South Porpoise
7. Outside Homeshore

EXCURSION RIVER

CHILKAT

①

② SAWMILL PT.

EXCURSION INLET

④ ③

EXCURSION PT.

PRESENT FISHING BOUNDARY
PREVIOUS FISHING BOUNDARY

PLEASANT

ISLAND

N. PORPOISE ISLAND

⑤

PENINSULA

HOMESHORE

S. PORPOISE ISLAND

⑥

ICY STRAIT

⑦

| 1 | 2 | 3 | MILES
| 1 | 2 | 3 | 4 | 5 | KILOMETERS

Figure 2. Map of Excursion Inlet showing test fishery sites and previous and
present southern fishing boundaries.

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from the Statewide Stock Separation project, with help from the southeastern regional staff, initiated a study in 1981 on the application of stock identification techniques, based on scale pattern analysis, to the Excursion Inlet chum salmon fishery. The objectives of this study were: (1) to develop a stock identification program to provide estimates of the contribution by river system to the commercial chum salmon harvest in Excursion Inlet; (2) to conduct a test fishery that, in coordination with stock identification techniques, will aid management biologists in assessing the effectiveness of boundary restrictions on the fishery, (3) to provide information on the age composition of chum salmon in the commercial catches and the escapement in northern Southeastern Alaska, and (4) to develop information contributing to a data base needed to achieve optimal sustained production through harvest regulation of northern Southeastern Alaska chum salmon stocks.

METHODS AND MATERIALS

Estimation of the stock composition of the Excursion Inlet chum salmon commercial and test fisheries required scale samples from both the fishery and escapements to the Excursion, Taku, and Chilkat Rivers.

Sample Collection

Escapement samples were taken by several different methods. A total of 553 chum salmon carcasses from the Excursion River was sampled for scales between 16 and 22 September. Samples from the Taku River were collected by the Canadian Department of Fisheries and Oceans. A total of 187 fish was sampled between 14 and 22 August by means of a fishwheel located at Canyon Island (Figure 1). An additional 430 scales were taken between 29 July and 12 October from the upriver Canadian gill net catch. A total of 1,383 chum salmon carcasses was also sampled from four spawning areas in the Chilkat River drainage, including 400 from the Klehini River on 13 October, 400 from Herman Creek on 14 October, 360 from 18-mile slough on the Chilkat River on 15 October, and 223 from the Chilkat River below Klukwan on 28 October.

Samples from the commercial catches were taken at fish processing facilities. Approximately 300 fish were sampled from each of the three Excursion Inlet fishery openings. Between 200 and 300 fish were sampled for each fishery opening in District 111 between 3 August and 8 October. An attempt was made to sample at least 300 fish for each fishery opening in District 115 between 6 July and 8 October.

The test fishery program at Excursion Inlet was designed to provide stock composition estimates of catches from specific areas along Homeshore, some of which are located outside the present fishing boundary. Purse seine vessels were chartered on four separate dates; they provided a total of nine separate catches from seven specific sample sites (Figure 2). Scale samples were taken from all captured chum salmon.

Age Composition

Chum salmon ages were determined through visual examination of the scale samples. Scales were collected from the left side of the fish approximately two rows above the lateral line and on the diagonal row downward from the posterior insertion of the dorsal fin (I.N.P.F.C. 1961). Scales were mounted on gum cards and impressions were made in cellulose acetate (Clutter and Whitesel 1956). Ages were recorded in European[2] notation, but are presented in this document in terms of total age.

Age composition estimates for each fishery were computed by fishing period. No samples were collected prior to 6 July for the District 115 fishery, or prior to 3 August for the District 111 fishery. The age composition estimates of the nearest date for the same fishery were applied to these periods. Age composition estimates for the 13-15 July and 10 August District 115 fishing periods, from which no samples were collected, were calculated by taking the averages of the periods immediately preceding and following these dates

Stock Identification

Estimates of the contribution of the Excursion, Chilkat, and Taku Rivers to the commercial and test fishery catches were made using linear discriminant function analysis based upon scale patterns and age composition data. Only five-year-old fish were analyzed, because of the lack of samples of other age classes in the escapement from the Excursion River. Because of variations in return timing, age composition, and probable differences in the scale growth patterns of summer and fall chum salmon, it was necessary to separate the total return of northern Southeastern Alaska chum salmon into summer and fall groups. Harvest levels and catch-per-unit-effort data by fishing period for the District 111 and District 115 gillnet fisheries were used to demarcate the summer and fall chum salmon runs.

Scale Measurements:

Scale impressions were magnified to 100 power and projected onto a digitizing tablet using equipment similar to that described by Ryan and Christie (1976). Data was recorded onto computer diskettes from the digitizer tablet under control of a FORTRAN program executing on a microcomputer. Scale measurements were taken along a standardized axis approximately 20 degrees off the primary axis and perpendicular to the sculptured field. The distance between each circulus in each of three scale pattern zones was measured. The zones were: (1) scale focus to the last circulus of the first marine annulus, (2) the last circulus of the first marine annulus to the last circulus of the second marine annulus, and (3) the last circulus of the second marine annulus to the last circulus of the third marine annulus. The three zones are shown in a photo-

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2 European Formula: Numerals preceding the decimal refer to the number of freshwater annuli; numerals following the decimal are the number of marine annuli. Total age is the sum of these two numbers plus 1.

graph of a scale from a 5-year-old chum salmon (Figure 3). A set of 11 variables was then computed for each of these three zones (Table 1).

Discriminant Function Analysis:

Linear discriminant function analysis (Fisher 1936; Dixon and Brown 1976) of scale pattern data was used to identify the origin of chum salmon sampled from the Excursion Inlet commercial and test fisheries. Scale pattern data from the escapements to the Excursion, Chilkat, and Taku Rivers were used as known samples to construct the discriminant functions.

Histograms of the distributions of each variable were examined. Non-normally distributed variables were not included in the discriminant function analysis. Stepwise discriminant function analysis of the remaining variables was used with an F level for inclusion set at 4.

Scale pattern data from the commercial and test fisheries at Excursion Inlet were classified and stock composition estimates were made for each catch. Stock estimates were then corrected for misclassification error rates using the procedures of Cook and Lord (1978). The variance and 90% confidence intervals for these estimates were then computed using the procedures of Pella and Robertson (1979).

Catch Apportionment:

The commercial and test fish catches were apportioned by age class and river system. A two-way stock identification model, capable of distinguishing Excursion from non-Excursion River (Taku and Chilkat) fish, was used to classify age 5 chum salmon from the commercial and test fisheries. Catches were apportioned into Excursion and non-Excursion groups using a combination of scale analysis and age composition techniques. An age 5 stock estimate of the contribution of Excursion River fish for a given catch was expanded to estimate the contribution of Excursion River fish for other age classes using the following formula:

$$\hat{S}_{EXC_i} = \hat{A}_{EXCi}/\hat{A}_{EXC\ 5}$$

Where:

$\hat{S}_{EXC_i}$ = Estimated proportion of Excursion River fish in the harvest of age i fish.

$\hat{A}_{EXC\ i}$ = Estimated proportion of age i fish in the Excursion River escapement.

$\hat{A}_{EXC\ 5}$ = Estimated proportion of age 5 fish in the Excursion River escapement.

All fish not apportioned to the Excursion River were assigned to the non-Excursion River group.
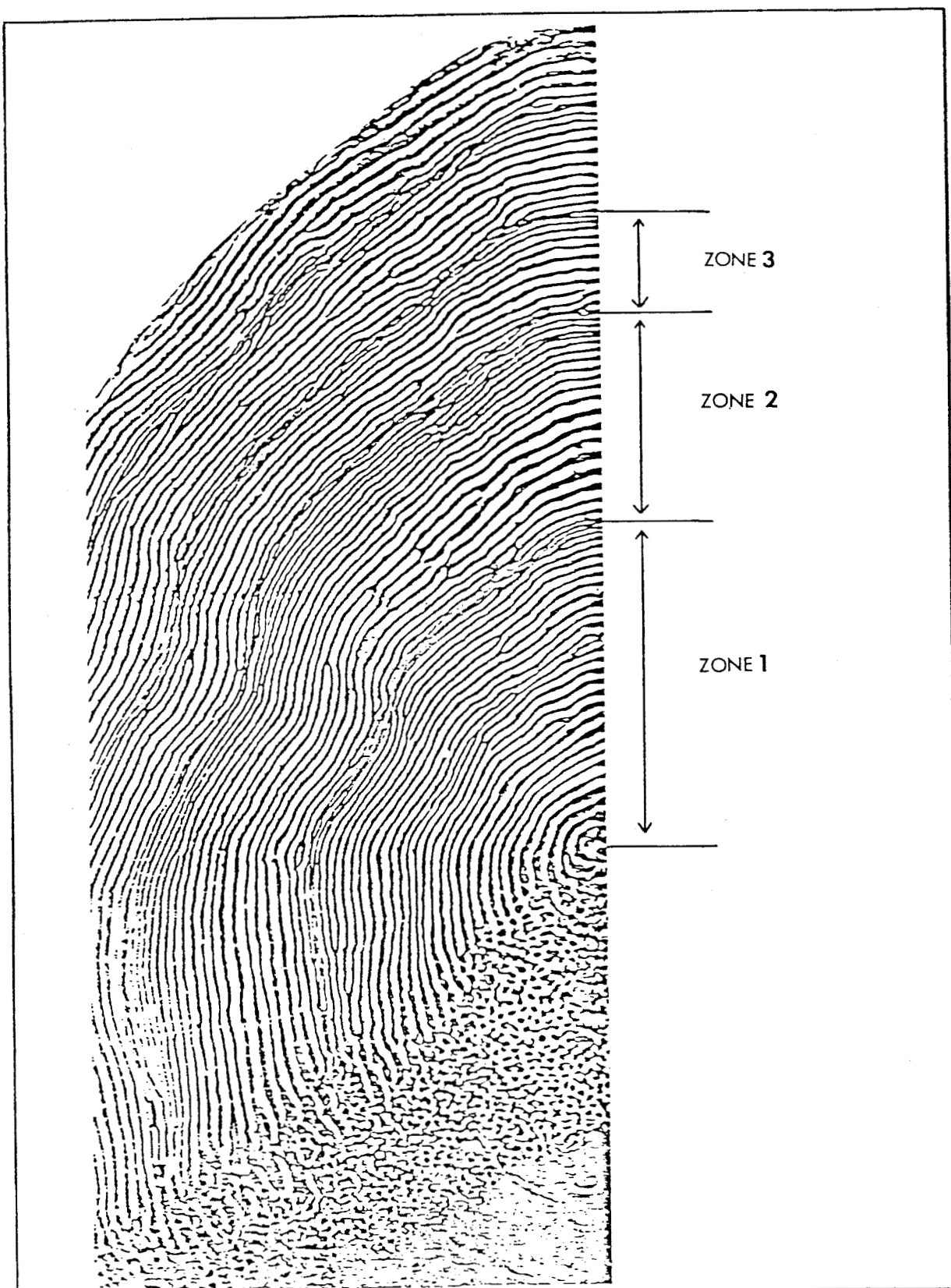
Figure 3. Photograph of a chum salmon scale showing the three zones measured.

Table 1. Variables computed from scale patterns for inclusion in the
linear discriminant function analysis.

Variable Name	Description
NC(i) [1]	Number of circuli in zone (i).
ID(i)	Measured size of zone (i).
TWO(i)	Distance from the beginning of zone (i) to the second circulus of zone (i).
FOUR(i)	Distance from the beginning of zone (i) to the fourth circulus of zone (i).
SIX(i)	Distance from the beginning of zone (i) to the sixth circulus of zone (i).
EIGHT(i)	Distance from the beginning of zone (i) to the eighth circulus of zone (i).
MIN(i)	Distance between the two closest circuli in zone (i).
MAX(i)	The maximum distance between two contiguous circuli in zone (i).
LMIN(i)	The distance from the beginning of the zone (i) to the first circulus of variable MIN(i) in zone (i).
LMAX(i)	The distance from the beginning of zone (i) to the first circulus of variable MAX(i) in zone (i).
NCH(i)	The number of circuli in the first half of zone (i).

[1] Where i=1,2,3.

Numbers of Fish

Separation of summer and fall runs of chum salmon was made by inspection of
District 111 and 115 gillnet harvest levels and catch-per-boat-hour data for
each fishing period. Data used to separate summer and fall chum salmon runs,
as well as the number of fish harvested by period in the Excursion Inlet purse
seine fishery, are summarized in this section. Available escapement estimates
for the Excursion, Taku, and Chilkat Rivers are also summarized. Catch and
escapement statistics were obtained from preliminary (February 1982) Alaska
Department of Fish and Game data summaries.

Catch:

The total harvest of both summer and fall run chum salmon in District 111 was
73,823 fish (Table 2). A Canadian gillnet fishery operating in the upper Taku
River, just inside the Canadian border, harvested an additional 5,493 chum
salmon (Table 3). The District 111 harvest occurred over a 13-week period
from 15 June to 8 September (Table 2). The harvest exhibited a bimodal pattern
with a small mode occurring in mid-July and a larger mode in late August. The
catch-per-boat-hour of fishing in District 111 also exhibited a bimodal pattern
(Figure 4). Visual inspection of the graph of the catch-per-boat-hour, by
week, over the duration of the fishing season, reveals a valley between the
two modes. The period during which this low point occurred was used to demar-
cate the summer and fall runs to the Taku River, with the fall run beginning
in statistical week 32 (Table 2).

The total harvest of chum salmon in District 115 was 115,908 fish. The har-
vest occurred over a 15-week period from 15 June to 22 September (Table 4).
The harvest exhibited a bimodal pattern with a small mode occurring in late
June and a larger mode in early September. The catch-per-boat-hour of fishing
in District 115 exhibited a number of peaks (Figure 5), with modes in early
July, mid-August, and late September. Highest catch-per-boat-hour occurred
during the last fishing period of the season. Visual inspection of the graph
of the catch-per-boat-hour for each period over the duration of the fishing
season reveals a low point which, as in the District 111 fishery, occurred in
late July (statistical week 31). The fall chum salmon run in District 115
was, therefore, also considered to begin in statistical week 32.

The total harvest of chum salmon in the Excursion Inlet commercial fishery was
97,799 fish (Table 5). The largest catch (55,207) occurred in the 24-25
August opening. Openings on 3 and 16 September netted 20,693 and 21,899 chum
salmon, respectively. An additional 1,492 chum salmon were caught in the
test fishery.

Escapement:

Accurate escapement estimates were unavailable for the Excursion, Taku, and
Chilkat Rivers. Each of these rivers are large glacial systems which often
exhibit turbid water conditions. Although escapements to these systems could

Table 2. Harvest of chum salmon in the District 111 gill net fishery by fishing period, 1981.

Statistical Week	Fishing Period	Hours (H)	Boats (B)	Weekly Catch (C)	Weekly Catch-Per-Boat-Hour
25	6/15-6/16	24	48	93	0.08
26	6/22-6/25	72	90	834	0.13
27	6/29-6/30	24	73	2,799	1.60
28	7/06-7/08	48	40	1,187	0.62
29	7/13-7/15	48	125	4,159	0.69
30	7/20-7/23	72	92	3,395	0.51
31	7/27-7/30	72	121	3,093	0.36
32	8/03-8/05	48	39	1,493	0.80
33	8/10-8/12	48	99	3,143	0.66
34	8/17-8/19	48	120	13,760	2.39
35	8/24-8/26	48	175	23,704	2.82
36	8/31-9/02	48	128	13,354	2.17
37	9/07-9/08	24	55	2,809	2.13
Total		624	1,205	73,823	

Table 3. Canadian harvest of chum salmon in the upper Taku River gill net fishery, 1981.

Statistical Week	Fishing Period	Hours (H)	Boats (B)	Weekly Catch (C)	Weekly Catch-Per-Boat-Hour
27	6/29-7/01	48	9	0	0.00
28	7/06-7/08	60	9	7	0.01
29	7/13-7/15	60	11	5	0.01
30	7/20-7/22 7/23-7/24	72	11	6	0.01
31	7/27-7/30	72	10	50	0.07
32	8/03-8/05	48	10	91	0.19
33	8/10-8/12	48	6	65	0.23
34	8/17-8/19	48	6	292	1.01
35	8/24-8/26	48	6	303	1.05
36	8/31-9/03	72	7	4,263	8.46
37	9/07-9/10	72	5	330	0.92
38	9/14-9/16	48	2	81	0.84
Total		648	155	5,493	
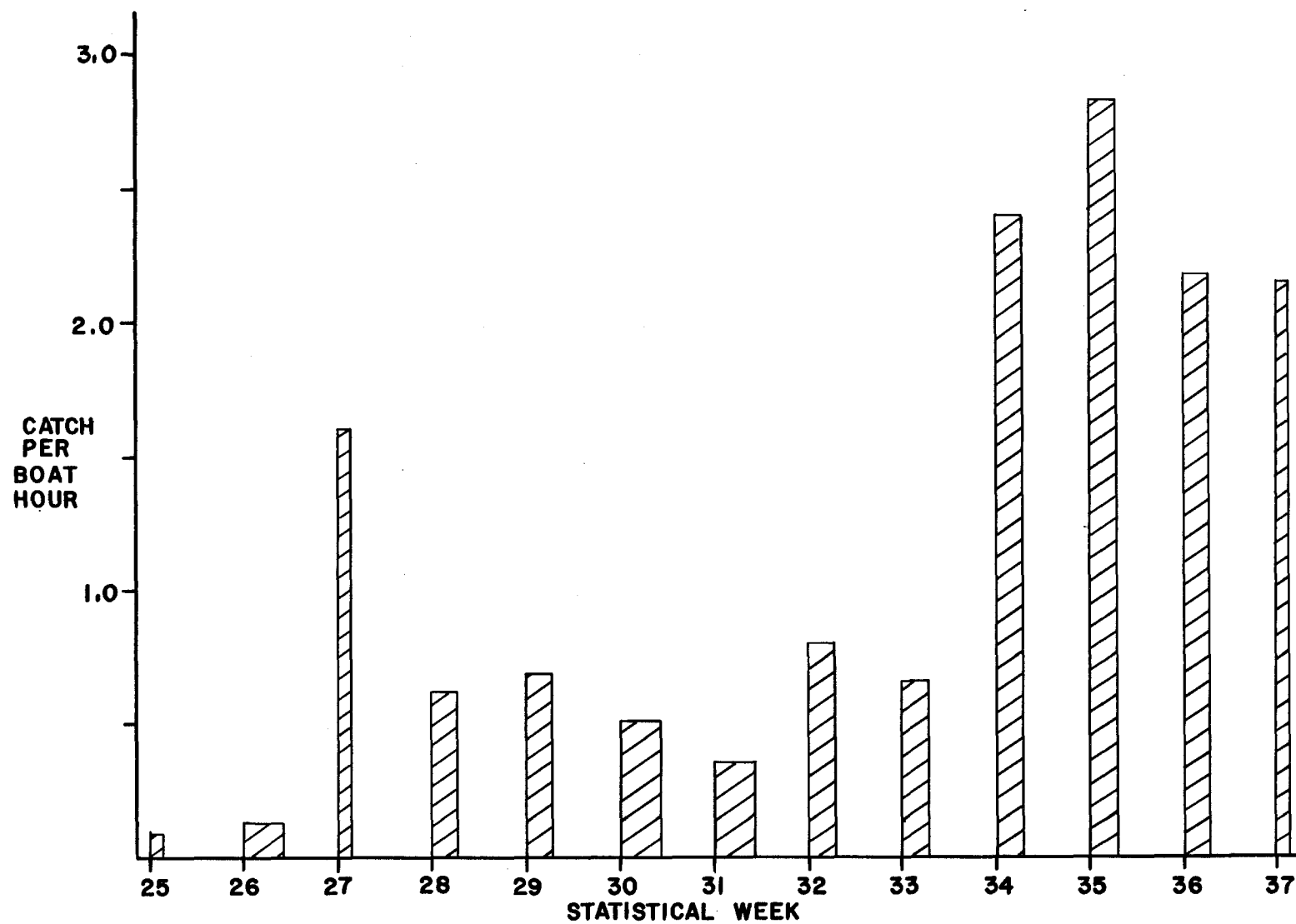
Figure 4. Catch-per-boat-hour of chum salmon by week in the District 111 gill net fishery,1981. Bar width corresponds to the number of hours fished per statistical week.

Table 4. Harvest of chum salmon in the District 115 gill net fishery by fishing period, 1981.

Statistical Week	Fishing Period	Hours (H)	Boats (B)	Weekly Catch (C)	Weekly Catch-Per-Boat-Hour
25	6/15-6/18	72	72	420	0.08
26	6/22-6/25	72	88	2,055	0.32
27	6/29-7/01	48	68	3,179	0.97
28	7/06-7/08	48	59	2,371	0.84
29	7/13-7/15	48	79	2,411	0.64
30	7/20-7/22	48	103	1,937	0.39
31	7/27-7/29	48	106	812	0.16
32	8/03-8/05	48	124	3,432	0.58
33	8/10	12	81	645	0.66
34	8/17-8/18	12	89	4,588	4.30
35	8/24-8/26	48	136	22,353	3.42
36	8/31-9/02	48	242	33,037	2.84
37	9/07-9/09	48	212	19,201	1.89
38	9/14-9/15	24	142	10,513	3.08
39	9/21-9/22	12	128	8,954	5.83
Total		636	1,729	115,908	
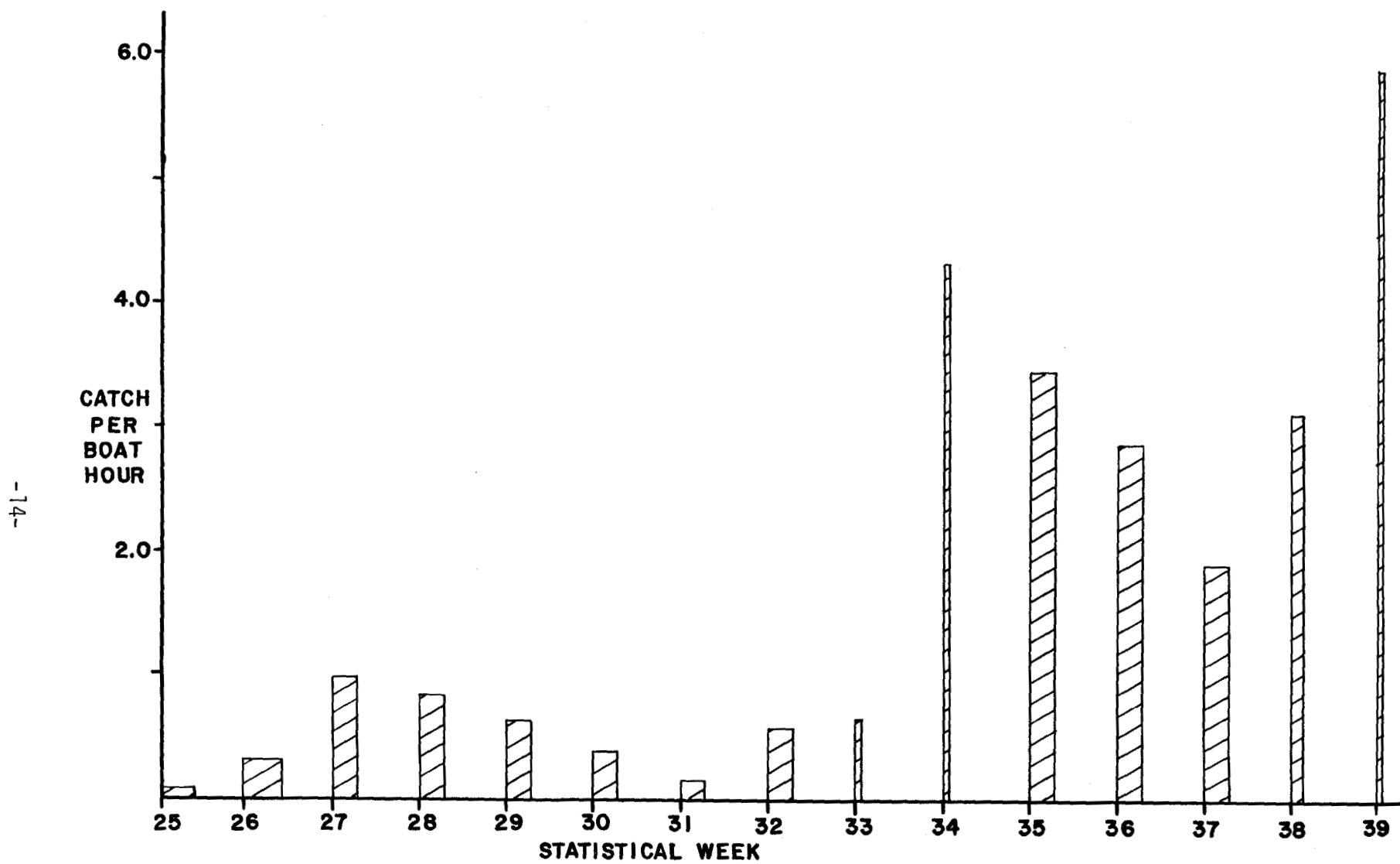
Figure 5. Catch-per-boat-hour of chum salmon by week in the District 115 gill net fishery, 1981. Bar width corresponds to the number of hours fished per statistical week.

Table 5. Harvest of chum salmon in Excursion Inlet purse seine fishery, 1981.

Statistical Week	Period	Hours (H)	Boats (B)	Catch (C)	Catch Per Boat Hour
35 [1]	8/24-8/25	24	68	55,207	33.83
36 [2]	9/03	12	55	20,693	31.35
38 [2]	9/16	12	35	21,899	52.14
Total		48	158	97,799	

[1] Northern boundary of fishing area set at 58° 27' 00" N.

[2] Northern boundary of fishing area set at 58° 28' 00" N.

theoretically be estimated through the aid of a sonar or a mark-recapture study, these tools were not employed in 1981 and only aerial and foot survey estimates were available. Aerial surveys of the Excursion and Taku Rivers provided peak escapement estimates of 33,500 and 4,490 chum salmon, respectively. A combination of aerial and foot surveys was used to derive an escapement estimate of 97,390 chum salmon for the Chilkat River drainage. While these estimates are of some use to fishery managers in regulating the fisheries on an in-season basis, they are not considered accurate because of the extreme variability involved in the effort and techniques used to derive them. Lack of accurate escapement counts precluded an effort to develop accurate total return estimates for each of these three runs.

Age Composition

The age composition of the commercial and test fishery catches and the escapements were estimated. Large differences were evident in the escapement age composition data which, by itself, provides insight into the stock composition of the Excursion Inlet catch.

Escapement:

The age composition of chum salmon sampled from the Excursion River on 16 and 22 September were very similar. Age 5 fish accounted for 91.5% of the escapement, followed by age 4 (8.3%) and age 3 (0.2%) fish (Table 6). Samples from the Canadian Taku River gillnet catch and the fishwheel on the Taku River exhibited almost identical age compositions, and were combined to represent the Taku River escapement. Age 5 fish were again the dominant age class, representing 65.5% of the escapement. Age 4 chum salmon accounted for 33.8% of the escapement, while age 3 fish comprised only 0.7% (Table 7). In the Chilkat River age 4 chum salmon predominated, accounting for 69.1% of the escapement. Only 27.2% of the Chilkat River escapement were age 5 fish, while 3.4% were age 3 and 0.3% were age 6 (Table 8).

The age composition of chum salmon from different spawning sites in the Chilkat River varied, but age 4 fish dominated in all areas. Of the specific sites sampled in the Chilkat River drainage, the age composition of the Klehini River and the Chilkat River (Klukwan) differed the most. A higher proportion of age 5 chum salmon were present in the Klehini River samples (33.5%) than the Klukwan samples (19.9%). Runs to these specific spawning sites are temporally segregated to some degree, with the Klehini fish generally returning earlier than the Klukwan fish (J. Helle, personal communication).

Commercial Catch:

The District 111 harvest (Table 9) was composed mostly of age 4 (49.6%) and age 5 (49.0%) fish, with the remaining 1.4% being age 3. No distinct changes of the principal age classes occurred throughout the season, but no samples were collected from the early summer run segment (15 June to 2 August).

The District 115 catch (Table 10) was composed primarily of age 4 fish (71.1%), followed by age 5 (23.6%), age 3 (5.0%), and age 6 (0.3%). The percentage of age 4 fish in the District 115 catch showed a general increase throughout the

Table 6. Age and sex composition of chum salmon sampled from the Excursion River, 1981.

Date		Age 3			Age 4			Age 5			Age 6			Total		
		Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total
9/16		0	1	1	2	5	7	48	56	104	0	0	0	50	62	112
9/22		0	0	0	18	16	34	162	186	348	0	0	0	180	202	382
Total	Numbers	0	1	1	20	21	41	210	242	452	0	0	0	230	264	494
	Percent	0.0	100.0	0.2	48.8	51.2	8.3	46.5	53.5	91.5	0.0	0.0	0.0	46.6	53.4	100.0

Data presented represent the percent of each age class which are males and females, and the percent each age class represents of the total sample.

Table 7. Age and sex composition of chum salmon sampled from the Taku River, 1981. The Canadian gill net fishery samples are listed first, followed by samples collected with a fishwheel at Canyon Island.

Sample Source	Date	Age 3 Male	Age 3 Female	Age 3 Total	Age 4 Male	Age 4 Female	Age 4 Total	Age 5 Male	Age 5 Female	Age 5 Total	Total Male	Total Female	Total
gill net													
	7/29	0	0	0	0	1	1	2	0	2	2	1	3
	8/3	0	0	0	0	1	1	0	0	0	0	1	1
	8/4	0	0	0	2	0	2	3	2	5	5	2	7
	8/9	0	0	0	0	1	1	1	1	2	1	2	3
	8/10	0	0	0	2	2	4	6	3	9	8	5	13
	8/11	0	0	0	4	2	6	3	2	5	7	4	11
	8/17	0	0	0	2	0	2	3	0	3	5	0	5
	8/18	0	0	0	10	5	15	27	22	49	37	27	64
	8/24	0	0	0	4	3	7	20	12	32	24	15	39
	8/25	1	1	2	14	6	20	25	13	38	40	20	60
	8/31	0	0	0	3	4	7	9	4	13	12	8	20
	9/1	0	0	0	10	9	19	22	9	31	32	18	50
	9/2	0	0	0	7	3	10	9	11	20	16	14	30
	9/9	0	0	0	3	1	4	4	2	6	7	3	10
	9/10	0	0	0	9	6	15	14	7	21	23	13	36
	9/11	0	0	0	10	3	13	8	7	15	18	10	28
	9/12	0	0	0	5	1	6	11	3	14	16	4	20
	Total Numbers	1	1	2	85	48	133	167	98	265	253	147	400
	Percent	50.0	50.0	0.5	63.9	36.1	33.3	63.0	37.0	66.2	63.2	36.8	100.0
fishwheel													
	8/14	0	0	0	2	1	3	1	5	6	3	6	9
	8/15	0	0	0	4	1	5	6	4	10	10	5	15
	8/16	0	0	0	6	3	9	6	14	20	12	17	29
	8/17	0	1	1	4	6	10	9	15	24	13	22	35
	8/18	1	0	1	9	10	19	12	14	26	22	24	46
	8/22	0	0	0	4	3	7	3	6	9	7	9	16
	Total Numbers	1	1	2	29	24	53	37	58	95	67	83	150
	Percent	50.0	50.0	1.3	54.7	45.3	35.3	38.9	61.1	63.3	44.7	55.3	100.0
gill net + fishwheel	Total Numbers	2	2	4	114	72	186	204	156	360	320	230	550
	Percent	50.0	50.0	0.7	61.3	38.7	33.8	56.7	43.3	65.5	58.2	41.8	100.0

Data presented represent the percent of each age class which are males and females, and the percent each age class represents of the total sample.

Table 8. Age and sex composition of chum salmon sampled from the Chilkat River drainage, 1981.

Location	Date		Age 3			Age 4			Age 5			Age 6			Total		
			Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total
Klehini River (31 mile slough)	10/13	Numbers	10	6	16	114	94	208	46	68	114	1	1	2	171	169	340
		Percent	62.5	37.5	4.7	54.8	45.2	61.2	40.4	59.6	33.5	50.0	50.0	0.6	50.3	49.7	
Herman Creek	10/14	Numbers	6	3	9	99	129	228	34	48	82	0	0	0	139	180	319
		Percent	66.7	33.3	2.8	43.4	56.6	71.5	41.5	58.8	25.7	0.0	0.0	0.0	43.6	56.4	
Chilkat River (18 mile slough)	10/15	Numbers	3	1	4	122	102	224	47	37	84	0	1	1	172	141	313
		Percent	75.0	25.0	1.3	54.5	45.5	71.6	56.0	44.0	26.8	0.0	100.0	0.3	55.0	45.0	
Chilkat River (Klukwan)	10/28	Numbers	10	1	11	106	52	158	28	14	42	0	0	0	144	67	211
		Percent	90.9	9.1	5.2	67.1	32.9	74.9	66.7	33.3	19.9	0.0	0.0	0.0	68.2	31.8	
Total		Numbers	29	11	40	441	377	818	155	167	322	1	2	3	626	557	1,183
		Percent	72.5	27.5	3.4	53.9	46.1	69.1	48.1	51.9	27.2	33.3	66.7	0.3	52.9	47.1	100.0

Data presented represent the percent of each age class which are males and females, and the percent each age class represents of the total sample.

Table 9. Age and sex composition of the District 111 gill net harvest by fishing period, 1981.

Statistical Week	Fishing Period	Sample Size		Age 3 Male	Age 3 Female	Age 3 Total	Age 4 Male	Age 4 Female	Age 4 Total	Age 5 Male	Age 5 Female	Age 5 Total	Age 6 Male	Age 6 Female	Age 6 Total	Total Male	Total Female	Tota
25-31	Prior 8/3[1]	0	Numbers	265	0	265	3,587	4,893	8,480	2,971	3,844	6,815	0	0	0	6,823	8,737	15,56
			Percent	100.0	0.0	1.7	42.3	57.7	54.5	43.6	56.4	43.8	0.0	0.0	0.0	43.8	56.2	
32	8/3-8/5	178	Numbers	25	0	25	344	470	814	285	369	654	0	0	0	654	839	1,49
			Percent	100.0	0.0	1.7	42.3	57.7	54.5	43.6	56.4	43.8	0.0	0.0	0.0	43.8	56.2	
33	8/10-8/12	271	Numbers	12	23	35	707	845	1,552	835	708	1,543	13	0	13	1,567	1,576	3,14
			Percent	33.3	66.7	1.1	45.5	54.5	49.4	54.1	45.9	49.1	100.0	0.0	0.4	49.9	50.1	
34	8/17-8/19	265	Numbers	55	55	110	2,646	3,684	6,330	3,375	3,945	7,320	0	0	0	6,076	7,684	13,76
			Percent	50.0	50.0	0.8	41.8	58.2	46.0	46.1	53.9	53.2	0.0	0.0	0.0	44.2	55.8	
35	8/24-8/26	284	Numbers	166	166	332	4,423	5,936	10,359	5,335	7,678	13,013	0	0	0	9,924	13,780	23,70
			Percent	50.0	50.0	1.4	42.7	57.3	43.7	41.0	59.0	54.9	0.0	0.0	0.0	41.9	58.1	
36	8/31-9/2	271	Numbers	100	100	200	1,431	6,261	7,692	1,524	3,938	5,462	0	0	0	3,055	10,299	13,35
			Percent	50.0	50.0	1.5	18.6	81.4	57.6	27.9	72.1	40.9	0.0	0.0	0.0	22.9	77.1	
37	9/7-9/8	281	Numbers	41	10	51	509	878	1,387	650	721	1,371	0	0	0	1,200	1,609	2,80
			Percent	80.0	20.0	1.8	36.7	63.3	49.4	47.4	52.6	48.8	0.0	0.0	0.0	42.7	57.3	
	Total	1,550	Numbers	664	354	1,018	13,647	22,967	36,614	14,975	21,203	36,178	13	0	13	29,299	44,524	73,82
			Percent	65.1	34.9	1.4	37.3	62.7	49.6	41.4	58.6	49.0	100.0	0.0	0.0	39.7	60.3	

[1] Scales were not collected prior to week 32. Age composition estimates from week 32 were applied for the total catch from weeks 25-31.

Table 10. Age and sex composition of the District 115 gill net harvest by fishing period, 1981.

Statistical Week	Fishing Period	Sample Size		Age 3			Age 4			Age 5			Age 6			Total		
				Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total
25-27	Prior 7/6 [1]	0	Numbers	40	20	60	1,034	1,294	2,328	1,331	1,771	3,102	0	0	0	2,405	3,085	5,490
			Percent	66.7	33.3	1.1	44.4	55.6	42.4	42.9	57.1	56.5	0.0	0.0	0.0	43.8	56.2	
28	7/6-7/8	276	Numbers	17	9	26	446	559	1,005	575	765	1,340	0	0	0	1,038	1,333	2,371
			Percent	66.7	33.3	1.1	44.4	55.6	42.4	42.9	57.1	56.5	0.0	0.0	0.0	43.8	56.2	
29	7/13-7/15 [2]	0	Numbers	20	4	24	548	687	1,235	517	635	1,152	0	0	0	1,085	1,326	2,411
			Percent	83.3	16.7	1.0	44.4	55.6	51.2	44.9	55.1	47.8	0.0	0.0	0.0	44.8	55.2	
30	7/20-7/22	240	Numbers	16	0	16	516	646	1,162	355	404	759	0	0	0	887	1,050	1,937
			Percent	100.0	0.0	0.8	44.4	55.6	60.0	46.8	53.2	39.2	0.0	0.0	0.0	45.8	54.2	
31	7/27-7/29	12	Numbers	0	0	0	250	187	437	250	62	312	0	0	0	500	249	749
			Percent	0.0	0.0	0.0	57.1	42.9	58.3	80.0	20.0	41.7	0.0	0.0	0.0	66.8	33.2	
32	8/3-8/5	243	Numbers	14	27	41	1,173	1,202	2,375	381	635	1,016	0	0	0	1,568	1,864	3,432
			Percent	33.3	66.7	1.2	49.4	50.6	69.2	37.5	62.5	29.6	0.0	0.0	0.0	45.7	54.3	
33	8/10 [3]	0	Numbers	18	30	48	716	833	1,549	312	467	779	0	0	0	1,046	1,330	2,376
			Percent	36.7	63.3	2.0	46.2	53.8	65.2	40.0	60.0	32.8	0.0	0.0	0.0	44.0	56.0	
34	8/17-8/18	354	Numbers	51	77	128	1,207	1,606	2,813	700	947	1,647	0	0	0	1,958	2,630	4,588
			Percent	40.0	60.0	2.8	42.9	57.1	61.3	42.5	57.5	35.9	0.0	0.0	0.0	42.7	57.3	
35	8/24-8/26	285	Numbers	626	156	782	8,073	7,217	15,290	2,978	3,214	6,192	89	0	89	11,766	10,587	22,353
			Percent	80.0	20.0	3.5	52.8	47.2	68.4	48.1	51.9	27.7	100.0	0.0	0.4	52.6	47.4	
36	8/31-9/2	152	Numbers	868	652	1,520	9,125	17,172	26,297	1,517	3,472	4,989	231	0	231	11,741	21,296	33,037
			Percent	57.1	42.9	4.6	34.7	65.3	79.6	30.4	69.6	15.1	100.0	0.0	0.7	35.5	64.5	
37	9/07-9/09	327	Numbers	587	411	998	6,577	7,690	14,267	2,055	1,881	3,936	0	0	0	9,219	9,982	19,201
			Percent	58.8	41.2	5.2	46.1	53.9	74.3	52.2	47.8	20.5	0.0	0.0	0.0	48.0	52.0	
38	9/14-9/15	265	Numbers	758	199	957	3,849	4,120	7,969	635	952	1,587	0	0	0	5,242	5,271	10,513
			Percent	79.2	20.8	9.1	48.3	51.7	75.8	40.0	60.0	15.1	0.0	0.0	0.0	49.9	50.1	
39	9/21-9/22	247	Numbers	872	435	1,307	2,830	3,877	6,707	398	542	940	0	0	0	4,100	4,854	8,954
			Percent	66.7	33.3	14.6	42.2	57.8	74.9	42.3	57.7	10.5	0.0	0.0	0.0	45.8	54.2	
	Total	2,401	Numbers	3,887	2,020	5,907	36,344	47,090	83,434	12,004	15,747	27,751	320	0	320	52,555	64,857	117,412
			Percent	65.8	34.2	5.0	43.6	56.4	71.1	43.3	56.7	23.6	100.0	0.0	0.3	44.8	55.2	

[1] Scales were not collected prior to week 28. Age composition estimates from week 28 were applied for the total catch from weeks 25-27.

[2] Scales were not collected from week 29. Age composition estimates from week 28 and week 30 were averaged and then applied to the catch from week 29.

[3] Scales were not collected from week 33. Age composition estimates from week 32 and week 34 were averaged and then applied to the catch from week 33.

season from 42.4% (6-8 July) to 74.9% (21-22 September). In addition, the
percentage of age 3 fish increased throughout the season from 1.1% (6-8 July)
to 14.6% (21-22 September). This data supports the observation of Dangel et
al. (1977) that, for a given run, older chum salmon tend to return earlier
in the season than younger fish.

The Excursion Inlet commercial catch (Table 11), unlike the District 111 and
115 catches, was comprised mainly of age 5 fish (77.6%), followed by age 4
(20.8%), age 3 (0.8%), and age 6 (0.8%). Age 5 fish were most common in the
24-25 August catch at Excursion Inlet (81.5%), while 71.2% of the 3 September
catch and 73.8% of the 16 September catch were age 5. The percentage of age 4
fish was lower in the 24-25 August catch (17.5%) than in the 3 September (26.7%)
or 16 September (23.6%) catches. Age 3 and age 6 fish were very scarce in all
three catches, each representing less than 2.5% of the total catch from each
opening.

Test Fishery Catch:

Significant trends existed in the age composition of temporally and spatially
segregated test fishery catches at Excursion Inlet (Table 12). Higher percent-
ages of age 4 fish appeared on each of the four fishing dates in those catches
made farther from the Excursion River. Based on the very low percent (8.3%)
of age 4 chum salmon in the Excursion River escapement and the higher propor-
tions of age 4 fish in the Taku (33.8%) and Chilkat (69.1%) escapements, it is
obvious that moving fish not destined for the Excursion River were more abun-
dant in catches moving south along the Homeshore. The most notable instances
of this trend occurred in the 1 September and 15 September test fish catches.
On 1 September age 4 chum salmon comprised only 12.7% of the catch at Sawmill
Point, while 60.3% of the catch at the Outside Homeshore site were age 4 fish.
On 15 September age 4 chum salmon comprised only 15.1% of the catch at the mouth
of the Excursion River, compared to 60.0% and 58.8% of the catches at the
Homeshore Line and South Porpoise sites, respectively. Higher percentages
of age 3 chum salmon, which were far more common in the Chilkat River escape-
ment (3.4%) than either the Excursion (0.2%) or Taku (0.5%) escapements, were
also apparent in test fish catches from sites located farther from the Excursion
River.

Stock Identification

Stock composition estimates of the Excursion Inlet commercial and test fish
catches were made using a combination of linear discriminant function analysis
and age composition data. Estimates of classification accuracy and confidence
intervals for the age specific stock composition estimates are of particular
importance because these factors define the power of the analysis.

Discriminant Analysis:

Histograms of the scale measurements showed that 5 of the 33 variables were
not normally distributed. These variables were excluded from subsequent
analyses. The non-normally distributed variables were LMAX1, LMIN1, LMIN2,
LMIN3, and NCH3.

Table 11. Age and sex composition of the Excursion Inlet purse seine chum salmon harvest by fishery opening, 1981.

Opening Date	Sample Size		Age 3 Male	Age 3 Female	Age 3 Total	Age 4 Male	Age 4 Female	Age 4 Total	Age 5 Male	Age 5 Female	Age 5 Total	Age 6 Male	Age 6 Female	Age 6 Total	Total Male	Total Female	Total
8/24-8/25	308	Numbers	0	166	166	5,014	4,647	9,661	23,127	21,867	44,994	193	193	386	28,334	26,873	55,207
		Percent	0.0	100.0	0.3	51.9	48.1	17.5	51.4	48.6	81.5	50.0	50.0	0.7	51.3	48.7	
9/3	277	Numbers	0	145	145	2,387	3,138	5,525	6,350	8,383	14,733	87	203	290	8,824	11,869	20,693
		Percent	0.0	100.0	0.7	43.2	56.8	26.7	43.1	56.9	71.2	0.3	0.7	1.4	42.6	57.4	
9/16	305	Numbers	288	216	504	1,938	3,230	5,168	6,400	9,761	16,161	66	0	66	8,692	13,207	21,899
		Percent	57.1	42.9	2.3	37.5	62.5	23.6	39.6	60.4	73.8	100.0	0.0	0.3	39.7	60.3	
Total	890	Numbers	288	527	815	9,339	11,015	20,354	35,877	40,011	75,888	346	396	742	45,850	51,949	97,799
		Percent	35.3	64.7	0.8	45.9	54.1	20.8	47.3	52.7	77.6	46.6	53.4	0.8	46.9	53.1	

Table 12. Age and sex composition of the Excursion Inlet purse seine chum salmon test fishing harvest by date, 1981.

Location	Date		Age 3			Age 4			Age 5			Age 6			Total		
			Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total
North Porpoise	8/23	Numbers	0	3	3	23	46	69	49	43	92	0	0	0	72	92	164
		Percent	0.0	100.0	1.8	33.3	66.7	42.1	53.3	46.7	56.1	0.0	0.0	0.0	43.9	56.1	
South Porpoise	8/23	Numbers	2	0	2	27	44	71	24	36	60	0	0	0	53	80	133
		Percent	100.0	0.0	1.5	38.0	62.0	53.4	40.0	60.0	45.1	0.0	0.0	0.0	39.8	60.2	
Sawmill Point	9/1	Numbers	0	0	0	9	12	21	60	83	143	1	0	1	70	95	165
		Percent	0.0	0.0	0.0	42.9	57.1	12.7	42.0	58.0	86.7	100.0	0.0	0.6	42.4	57.6	
Outside Home-shore	9/1	Numbers	4	2	6	53	41	94	25	31	56	0	0	0	82	74	156
		Percent	66.7	33.3	3.8	56.4	43.6	60.3	44.6	55.4	35.9	0.0	0.0	0.0	52.6	47.4	
Excursion Point	9/11	Numbers	1	0	1	7	7	14	17	18	35	0	0	0	25	25	50
		Percent	100.0	0.0	2.0	50.0	50.0	28.0	48.6	51.4	70.0	0.0	0.0	0.0	50.0	50.0	
North Porpoise	9/11	Numbers	11	4	15	45	48	93	30	50	80	0	0	0	86	102	188
		Percent	73.3	26.7	8.0	48.4	51.6	49.4	37.5	62.5	42.6	0.0	0.0	0.0	45.7	54.3	
Excursion River-mouth	9/15	Numbers	0	3	3	19	29	48	93	173	266	0	0	0	112	205	307
		Percent	0.0	100.0	0.9	39.6	60.4	15.1	35.0	65.0	84.0	0.0	0.0	0.0	35.3	64.7	
Homeshore Line	9/15	Numbers	10	5	15	50	67	117	29	33	62	0	1	1	89	106	195
		Percent	66.7	33.3	7.7	42.7	57.3	60.0	46.8	53.2	31.8	0.0	100.0	0.5	45.6	54.4	
South Porpoise	9/15	Numbers	9	2	11	37	36	73	15	24	39	1	0	1	62	62	124
		Percent	81.8	18.2	8.9	50.7	49.3	58.8	38.5	61.5	31.5	100.0	0.0	0.8	50.0	50.0	
Total		Numbers	37	19	56	270	330	600	342	491	833	2	1	3	651	841	1,492
		Percent	66.1	33.9	3.8	45.0	55.0	40.2	41.1	58.9	55.8	66.7	33.3	0.2	43.6	56.4	

Summary statistics of the scale variables computed for age 5 Excursion, Chilkat, and Taku River chum salmon and used in the analysis are summarized in Table 13. These data reveal that Excursion River fish exhibited greater growth in the early portion of their first marine year (FOUR1, SIX1, EIGHT1), and less growth in their second (ID2) and third (ID3) marine years than fish from the Chilkat and Taku Rivers.

The overall jacknifed classification[3] accuracy of the 3-way age 5 model was 55.4% (Table 14). The Excursion River stock showed the best classification accuracy at 70.1%, while the Chilkat (53%) and Taku (42%) stocks were not as distinct. Because of the poor overall classification of the 3-way model and the distinctness of the Excursion River stock, the Chilkat and Taku stocks were pooled and a 2-way model was developed. An additional 92 scales from the Excursion River were measured to equalize the sample sizes of the two groups. The overall jacknifed classification accuracy of the 2-way model was 77.9% (Table 15). The 2-way model was then used to classify stocks of unknown origin in the commercial and test fishery catches.

Age Specific Stock Composition Estimates:

Scales taken from test fishery catches at the mouth of the Excursion River and Sawmill Point were aged, but detailed scale measurements were not taken. The age compositions of these catches were very similar to that of the Excursion River escapement, indicating that both catches were composed primarily of Excursion River fish. Scale measurements from the test fishery catch at Excursion Point were also not made because of the small number of fish caught in this set.

The vast majority of age 5 chum salmon caught in the Excursion Inlet commercial fishery were from the Excursion River. The percentage of age 5 Excursion River fish increased in each period (Table 16), comprising 87.5% of the catch on 24-25 August, 96.8% on 3 September, and 99.0% on 16 September.

Age class specific stock composition estimates of the test fishery catches (Table 17) generally revealed much lower proportions of Excursion River fish (9.9%-90.1%) than did the commercial catches (87.5%-99.0%). The contribution of other age classes must be considered, however, to obtain a complete understanding of stock contribution to the commercial and test fishery harvests.

Catch Apportionment:

The harvest of 97,799 chum salmon in the Excursion Inlet commercial fishery was comprised of 68,258 (69.8%) Excursion River fish and 29,541 (30.2%) non-Excursion River (Chilkat and Taku) fish (Table 18). The percent of Excursion River fish in the commercial catches was fairly consistent, varying between a high of 72.9% in the 24-25 August period and a low of 64.7% in the 3 September

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[3] A jacknifed classification matrix is constructed by classifying each individual fish into a group based upon classification functions computed from all the data except the case being classified.

Table 13. Mean values and standard deviations of scale pattern variables used in the discriminant analysis of Excursion, Chilkat, and Taku River age 5 chum salmon, 1981[1].

Variable	Excursion River		Chilkat River		Taku River	
	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation
TWO1	40.112	10.032	42.650	8.872	39.570	9.423
FOUR1	76.645	14.003	73.460	11.661	69.210	13.256
SIX1	114.234	16.310	102.630	14.150	99.000	16.921
EIGHT1	149.140	17.651	132.560	16.546	131.360	21.004
MAX1	27.570	5.096	28.670	5.623	27.160	5.352
MIN1	7.514	1.334	7.540	1.283	7.340	1.437
NC1	31.523	2.611	31.880	2.524	32.630	2.427
ID1	502.598	49.154	492.080	47.055	506.680	55.456
NCH1	13.664	1.523	14.550	1.533	14.700	1.697
TWO2	28.271	5.895	28.070	6.274	26.980	5.423
FOUR2	65.421	9.222	65.490	10.537	63.710	10.350
SIX2	102.028	11.032	103.370	13.148	101.750	13.402
EIGHT2	137.421	13.825	139.450	14.805	138.740	16.898
MAX2	22.495	2.840	23.340	2.868	22.670	2.701
MIN2	7.318	1.451	6.890	1.435	7.150	1.708
LMAX2	5.271	2.690	5.230	2.436	5.690	2.448
NC2	18.000	2.051	19.190	2.196	19.200	2.314
ID2	264.056	34.695	283.400	31.443	287.230	33.469
NCH2	7.196	0.946	7.670	1.256	7.780	1.133
TWO3	22.822	5.618	25.150	5.480	24.520	6.144
FOUR3	54.140	9.978	56.940	8.995	57.430	10.907
SIX3	82.897	13.182	86.850	14.577	89.040	15.432
EIGHT3	103.916	23.801	111.230	20.993	116.490	19.345
MAX3	18.150	3.259	18.820	3.010	19.160	3.676
MIN3	6.963	1.529	7.210	1.526	7.220	1.936
LMAX3	3.897	1.447	3.940	1.594	4.330	1.867
NC3	10.308	1.783	10.790	1.788	11.090	2.011
ID3	127.879	24.652	140.000	28.162	148.140	31.851

[1] Based on sample sizes of 107 for the Excursion River, and 100 for each of the Chilkat and Taku Rivers.

Table 14. Three-way jacknife classification matrix from discriminant analysis of Excursion, Chilkat, and Taku River age 5 chum salmon, 1981.

Actual Group of Origon	Sample Size	Classified Group of Origon		
		Excursion	Chilkat	Taku
Excursion	107	.701	.131	.168
Chilkat	100	.180	.530	.290
Taku	100	.250	.330	.420

overall classification accuracy=.554

Table 15. Two-way jacknife classification matrix from discriminant analysis of Excursion, Chilkat, and Taku River age 5 chum salmon, 1981.

Actual Group of Origon	Sample Size	Classified Group of Origon	
		Excursion	Other(Chilkat,Taku)
Excursion	199	.769	.231
Other (Chilkat,Taku)	200	.210	.790

overall classification accuracy=.779

Note:Underlined proportions represent proportion correctly classified. All other proportions are misclassified.

Table 16. Age class specific stock composition estimates and 90% confidence intervals calculated from scale pattern analysis of age 5 chum salmon in the Excursion Inlet commercial catch,1981.

Period	Excursion	Chilkat/Taku
8/24-8/25	.875±.156	.125±.156
9/3	.968±.153	.032±.153
9/16	.990±.151	.010±.151

Table 17. Age class specific stock composition estimates and 90% confidence intervals calculated from scale pattern analysis of age 5 chum salmon in the Excursion Inlet test fishery, 1981.

Location	Period	Excursion	Chilkat/Taku
North Porpoise	8/23	.884±.171	.116±.171
South Porpoise	8/23	.099±.194	.901±.194
Outside Homeshore	9/1	.412±.216	.588±.216
North Porpoise	9/11	.503±.208	.497±.208
Homeshore Line	9/15	.632±.207	.368±.207
South Porpoise	9/15	.578±.275	.422±.275

Table 18. Stock composition estimates of chum salmon catches by age class and fishing period for the Excursion Inlet commercial fishery, 1981.

Date	System	%	Age 3 Numbers	%	Age 4 Numbers	%	Age 5 Numbers	%	Age 6 Numbers	%	Total Numbers
8/24-8/25	Excursion	0.4	1	9.1	879	87.5	39,370	0.0	0	72.9	40,247
	Chilkat/Taku	99.6	165	90.9	8,782	12.5	5,624	100.0	386	27.1	14,960
	Total	100.0	166	100.0	9,661	100.0	44,994	100.0	386	100.0	55,207
9/3	Excursion	0.4	1	9.1	503	87.5	12,891	0.0	0	64.7	13,393
	Chilkat/Taku	99.6	144	90.0	5,022	12.5	1,842	100.0	290	35.3	7,300
	Total	100.0	145	100.0	5,525	100.0	14,733	100.0	290	100.0	20,693
9/16	Excursion	0.4	2	9.1	470	87.5	14,141	0.0	0	66.7	14,612
	Chilkat/Taku	99.6	502	90.9	4,698	12.5	2,020	100.0	66	33.3	7,287
	Total	100.0	504	100.0	5,168	100.0	16,161	100.0	66	100.0	21,899
Total	Excursion	0.4	4	9.1	1,852	87.5	66,402	0.0	0	69.8	68,258
	Chilkat/Taku	99.6	811	90.9	18,502	12.5	9,486	100.0	742	30.2	29,541
	Total	100.0	815	100.0	20,354	100.0	75,888	100.0	742	100.0	97,799

period.

The test fishery catches made at or outside the southern fishery boundary, however, were comprised primarily of non-Excursion River fish. For specific dates when more than one test fishery site was sampled, the site farthest from the mouth of the Excursion River exhibited the higher percentage of non-Excursion River fish. This trend was most apparent in the test fishery of 23 August when the North Porpoise catch was comprised of 53.0% Excursion River fish while the South Porpoise catch consisted of only 9.3% Excursion River fish (Table 19).

DISCUSSION

Scale pattern analysis of 5-year-old chum salmon, in combination with age composition data, permitted the 1981 Excursion Inlet purse seine harvest to be apportioned into Excursion River and non-Excursion River (Chilkat and Taku) groups.

A three-way classification model capable of distinguishing all stocks was not used to apportion catches because of the low classification accuracies, of the Taku (42.0%) and Chilkat River (53.0%) fish. The low classification accuracies of these stocks was probably attributable to two factors: (1) the diversity of spawning and rearing habitats within each river, and (2) the presence of discrete spawning groups within each system. The Chilkat and Taku River drainages are each large glacial systems possessing a wide variety of aquatic habitats that are subject to extreme changes in hydrological conditions. Variability in growth rates as reflected by differences in scale patterns would be expected within such river systems. Temporal differences in return timing of summer and fall chum salmon runs to these rivers, in addition to the existence of numerous discrete spawning areas in each river, undoubtedly cause some degree of reproduction isolation among spawning groups within each river.

The Excursion River chum salmon run is a relatively homogeneous population, however, comprised almost entirely of fall run fish that spawn in upwelling areas in the lower reaches of the river. The higher classification accuracy of the Excursion River fish (70.1%) in the three-way classification model is, therefore, not surprising; such a trend could probably be expected in future years.

The current strategy used to manage fall chum salmon fisheries in Southeastern Alaska is based primarily on in-season aerial abundance surveys and trends in catch data. No formal forecasts have historically been made for Southeastern Alaska chum salmon runs due to the unavailability of estimates for the catch, escapement, and total returns by stock. Development of a data base suitable for forecasting run strength is needed for sound management of fall chum salmon stocks.

Apportionment of the Excursion Inlet purse seine catch by stock could be determined by scale pattern analysis and, used together with catch statistics from the District 111 and 115 gill net fisheries, to provide estimates of the total harvest of chum salmon for the Chilkat, Excursion, and Taku River stocks.

Table 19. Stock composition estimates of select chum salmon catches by age class and date for the Excursion Inlet test fishery, 1981.

Date	Location	System	%	Age 3 Numbers	%	Age 4 Numbers	%	Age 5 Numbers	%	Age 6 Numbers	%	Total Numbers
8/23	North Porpoise	Excursion	0.4	0	9.1	6	88.4	81	0.0	0	53.0	87
		Chilkat/Taku	99.6	3	90.9	63	11.6	11	0.0	0	47.0	77
		Total	100.0	3	100.0	69	100.0	92	0.0	0	100.0	164
8/23	South Porpoise	Excursion	0.4	0	9.1	7	9.9	6	0.0	0	9.3	13
		Chilkat/Taku	99.6	2	90.9	68	90.1	57	0.0	0	90.7	127
		Total	100.0	2	100.0	75	100.0	63	0.0	0	100.0	140
9/1	Outside Home-shore	Excursion	0.4	0	9.1	9	41.2	24	0.0	0	20.5	33
		Chilkat/Taku	99.6	6	90.9	88	58.8	34	0.0	0	79.5	128
		Total	100.0	6	100.0	97	100.0	58	0.0	0	100.0	151
9/11	North Porpoise	Excursion	0.4	0	9.1	9	50.3	43	0.0	0	26.0	52
		Chilkat/Taku	99.6	16	90.9	90	49.7	42	0.0	0	74.0	148
		Total	100.0	16	100.0	99	100.0	85	0.0	0	100.0	200
9/15	Homeshore Line	Excursion	0.4	0	9.1	12	63.2	43	0.0	0	25.8	55
		Chilkat/Taku	99.6	16	90.9	116	36.8	25	100.0	1	74.2	158
		Total	100.0	16	100.0	128	100.0	68	100.0	1	100.0	213
9/15	South Porpoise	Excursion	0.4	0	9.1	7	57.8	24	0.0	0	23.7	31
		Chilkat/Taku	99.6	12	90.9	70	42.2	17	100.0	1	76.3	100
		Total	100.0	12	100.0	77	100.0	41	100.0	1	100.0	131

In addition to harvest levels by stock, escapement counts are needed to develop total return estimates for each of these three river systems. A variety of methods are available to estimate escapements. A tag and recovery program could be easily developed to provide an escapement estimate for the Excursion River. Prior to entering the Excursion River chum salmon tend to mill at the rivermouth. Fish could be seined, tagged, and later recovered on the spawning grounds, and a population estimate derived.

The use of sonar equipment on the Taku River, together with a fishwheel operation designed to sample species composition, could feasibly be used to estimate the Taku River fall chum salmon escapement (Gaudet, Alaska Department of Fish and Game, personal communication). Successful operation of a fishwheel on the Taku River was first documented during the 1950's by the Alaska Department of Fish and Game (Alaska Dept. of Fish and Game, Annual Report, 1958). Canadian biologists have tagged fish captured with a fishwheel at Canyon Island on the Taku River and used tag recovery rates in the upriver Canadian gill net fishery to estimate escapements to the Taku River (Johnson, Fisheries and Oceans - Canada, personal communication). Though this technique has proven useful in the past, the small size of catches in the Canadian fishery limit the accuracy of this escapement estimation technique.

Escapement enumeration on the Chilkat River would be much more difficult. The physical characteristics of the Chilkat River preclude the use of weirs and sonar units to accurately count escapements. Previous tag and recovery efforts to estimate returns to the Chilkat River have not proven successful because of poor water visibility and the difficulty of recovering significant numbers of tagged fish from mainstem spawning areas (Jones et al. 1980).

In addition to total return estimates several other types of data could be used to aid run forecasting. Pre-emergent fry indices are used as a factor in forecasting pink salmon returns in Southeastern Alaska. Establishment of a pre-emergent chum salmon sampling program for the three large fall chum salmon producers in northern Southeastern Alaska would involve a minimal expense of money and effort. A data base of air and sea surface temperatures presently exists and will continue to be appended with future years' data. This information has proven useful in forecasting pink salmon (O. gorbuscha) runs in Southeastern Alaska and undoubtedly would be important in developing chum salmon forecasts for this region as well.

In summary, scale pattern analysis was shown to be of value to the management of fall chum salmon runs in northern Southeastern Alaska. Apportionment of the 1981 harvest of chum salmon in the Excursion Inlet purse seine fishery provide an estimate of the contribution of Excursion and non-Excursion River stocks to the fishery. Analysis of test fishery data suggested that the restructuring of the fishing boundary at Excursion Inlet reduced the interception of Chilkat and Taku River fish in 1981 at Excursion Inlet.

Development of techniques to estimate escapements, in combination with a continuing program of scale pattern analysis of commercial catches, could permit the estimation of total return by stock for fall chum salmon in northern Southeastern Alaska. Total return estimates together with pre-emergent fry indices and environmental data could be used to develop forecasts of fall chum salmon returns, and would thus be extremely valuable to the management of chum salmon stocks in this region.

SUMMARY

1. The age composition of the Excursion, Chilkat, and Taku River chum salmon escapements were markedly different in 1981. The escapement to the Excursion River was comprised primarily of age 5 (91.5%) fish, as was the Taku River escapement (65.5%). Age 4 fish comprised the majority (69.1%) of the escapement to the Chilkat River drainage.

2. The age composition of the District 111 gill net harvest remained fairly constant throughout the fishing season and was comprised primarily of age 4 (49.6%) and age 5 (49.0%) chum salmon.

3. The District 115 gill net harvest was comprised primarily of age 4 (71.1%) and age 5 (23.6%) fish. A distinct shift in age composition from older to younger fish occurred as the season progressed.

4. The Excursion Inlet purse seine harvest was comprised primarily of age 5 (81.5%) fish.

5. Age composition analysis of the test fishery harvest at Excursion Inlet revealed a higher proportion of age 4 chum salmon at sites moving south along Homeshore.

6. The harvest of 97,799 chum salmon in the Excursion Inlet commercial fishery was comprised of 68,258 (69.8%) Excursion River fish and 29,541 (30.2%) non-Excursion (Chilkat and Taku) fish.

7. Apportionment of test fishery catches by stock suggested that the boundary restriction imposed in 1980 on the Excursion Inlet fishery significantly reduced the interception of Chilkat and Taku River chum salmon stocks at Excursion Inlet in 1981.

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